**Question 1**

Original state

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
| H / T |  |  |  |  |  |

Enqueue(4)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 4 |  |  |  |  |  |
| H | T |  |  |  |  |

Enqueue(1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 4 | 1 |  |  |  |  |
| H |  | T |  |  |  |

Enqueue(3)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 4 | 1 | 3 |  |  |  |
| H |  |  | T |  |  |

Dequeue()

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 1 | 3 |  |  |  |
|  | H |  | T |  |  |

Enqueue(8)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 1 | 3 | 8 |  |  |
|  | H |  |  | T |  |

Dequeue()

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | 3 | 8 |  |  |
|  |  | H |  | T |  |

Question 2:

[3, 14, 27, 31, 39, 42, 55, 70, 74, 81, 85, 93, 98]

a. How many times the outermost if statement is executed for:

**Key = 55**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3 | 14 | 27 | 31 | 39 | 42 | 55 | 70 | 74 | 81 | 85 | 93 | 98 |

First iteration of while loop

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3 | 14 | 27 | 31 | 39 | 42 | 55 | 70 | 74 | 81 | 85 | 93 | 98 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |

Compare against key:

Found the key, return

**Key = 70**

First iteration of while loop

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3 | 14 | 27 | 31 | 39 | 42 | 55 | 70 | 74 | 81 | 85 | 93 | 98 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |

Compare against key:

, so move to :

Second iteration:

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3 | 14 | 27 | 31 | 39 | 42 | 55 | 70 | 74 | 81 | 85 | 93 | 98 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |

Compare against the key:

, so move to :

Third iteration:

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3 | 14 | 27 | 31 | 39 | 42 | 55 | 70 | 74 | 81 | 85 | 93 | 98 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |

so **return**

So we need 3 iterations, or the outermost if statements were executed 3 times.

**Key = 72**

First iteration of while loop

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **3** | **14** | **27** | **31** | **39** | **42** | **55** | **70** | **74** | **81** | **85** | **93** | **98** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |

Compare against key:

, so move to :

Second iteration:

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3 | 14 | 27 | 31 | 39 | 42 | 55 | **70** | **74** | **81** | **85** | **93** | **98** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |

Compare against the key:

, so move to :

Third iteration:

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3 | 14 | 27 | 31 | 39 | 42 | 55 | **70** | **74** | 81 | 85 | 93 | 98 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |

, so move to

Fourth iteration

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3 | 14 | 27 | 31 | 39 | 42 | 55 | 70 | **74** | 81 | 85 | 93 | 98 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |

, so move to :

Check the while loop condition: false. So stop the while loop.

Return -1.

So we need 4 iterations, or the outermost if statements were executed 4 times.

14 (maybe 3 iterations?)

b. For the binary search algorithm:

Since .

In the next iteration, we would have less than or at least half of the elements.

Answer: iii, reduced to